

Vending Machine Monitoring System



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Introduction

- Problem:
 - Maintaining vending machine inventory
 - Other forms of communication:
 - Expensive
 - Time-Consuming
- Solution:
 - Cheaper alternative to vending communication
 - Improve maintenance efficiency

Product Function

- Device reads status information from vending machine controller (DEX)
- Device alerts consumer with LCD message to call a phone system/enter code
- Consumer receives new code and free beverage

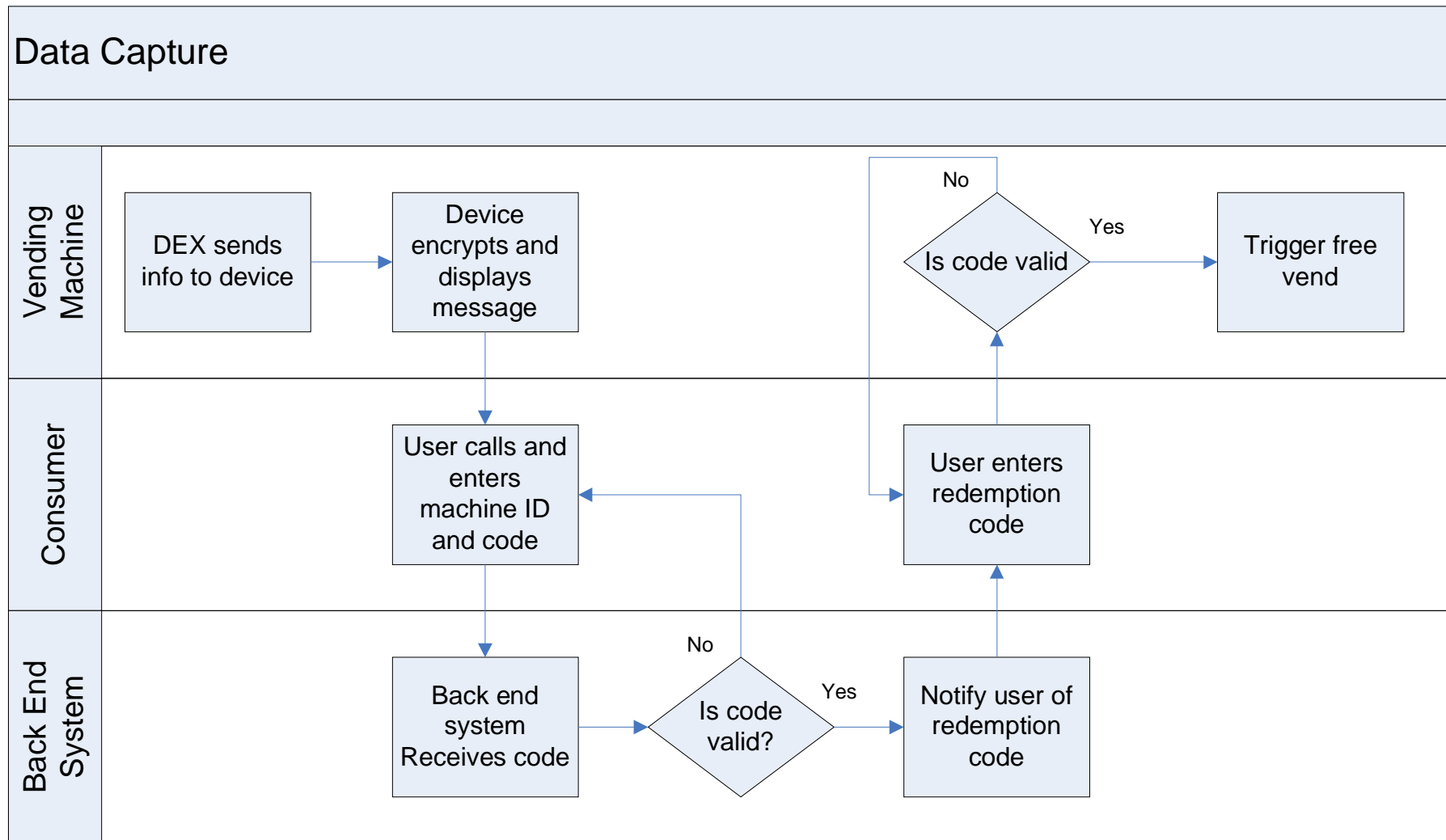
Requirements

- Information Wanted:
 - Worst-case: machine needs servicing based on inventory level of one product
 - Next-best: which selections are low
 - Best-case: full inventory level
 - Location / identification of machine
- Unique encrypted codes
- Triggers only once until re-serviced

Requirements Cont'd

- Encryption keys provided to Appolis
- No more than 16 digit code
- LCD, LED, and keypad placed outside machine
- Remaining hardware components to fit inside machine
- Client requests C# language for software

Project Flow Chart



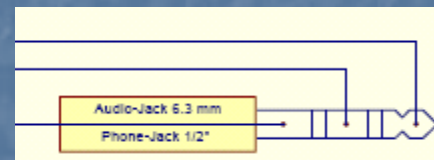
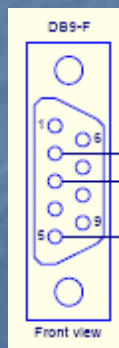
Technical / Design Content

- Peter: DEX Communication
- Birendra: Encryption
- Shannon: Hardware

DEX

- Serial Communication (RS-232)
- Using three software handshakes
- Cable (schematic below) for transfer

Diagram Provided
by Bonusdata.net



Serial Communication

- Baud Rate: 9600
- Defining serial port in C#
- Wait times – tested

DEX information

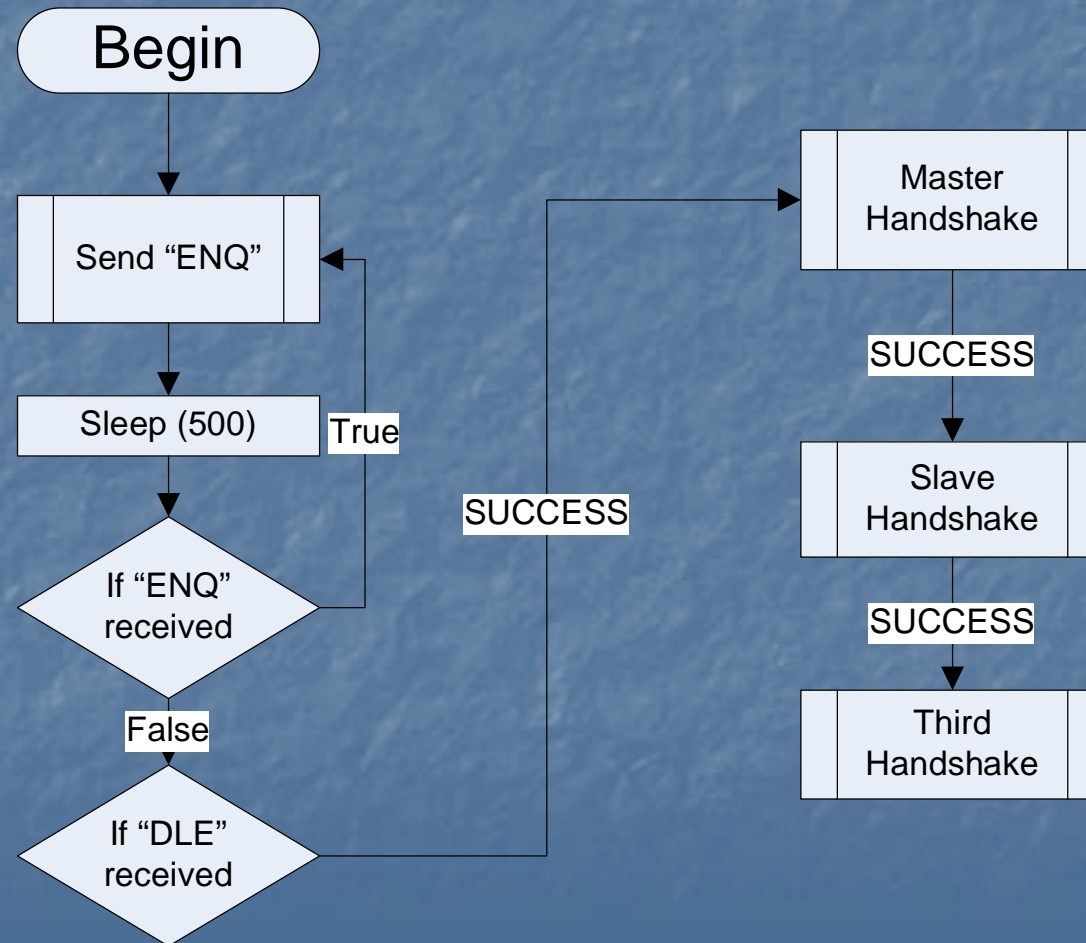
- DEX raw data provides the following information:
 - Machine serial number
 - Sales summary
 - Overall or per product
 - Money Contained (Coins, Bills)
 - Item sold out date

DEX testing

- 1st: Computer application
- Transferred to ARM micro
- Differences between two:
 - Timeout on serial reading
 - Defining comm ports

DEX Main Flow Chart

Main Program



DEX Handshakes

- Master
- Slave
 - Receive Header – includes audit date
- Third
 - Alternate_answer function
 - Our machine: 27 blocks
 - Compare sold-out date to audit date
 - Changes variable if match

DEX Summary

- Serial Communication (RS-232)
- Check status after each vend
- Trigger beverage vend
- Can provide which items are sold out
- Our customer would like the capability to provide inventory
 - DEX does not directly provide inventory
 - Counter reset each time machine filled could solve this

Encryption/Decryption

- Generating Code
- Sending Code
- DEX Code
- DEX Info
- Inventory Status Message
- Encryption Algorithm

Generating the Code

- Information from the vending machine is acquired through DEX Communication
- The inventory status is analyzed and the message is generated
- Message is sent in two steps
 - Machine ID (10)
 - Encrypted code for the Inventory status (8)
- '1' is used to notify an inventory emergency. '0' denotes a normal state
- If a product is sold-out, it is assigned a '1' and a '0' otherwise
- Machine ID is not encrypted

Sending the Code

- The message, generated after analyzing the information from the vending machine , is encrypted using Key1
- The customer is displayed a screen with the Phone number and the Machine ID
- Then the Encrypted code is displayed
- The user sends the encrypted code and receives a Promo Code
- After verifying the Promo code, the user gets a free Pop!!

The DEX Code

- The info used to generate the Inventory Status Msg
 - MachineID
 - Audit Read Date
 - Sold out date for each product
 - Coin box info

DEX Info

DXS*6150210000*VA*V1/1*1	//MachineID
EA3**181201*1715	//Audit Read Date
PA1*1*25*	
PA5*181126*1728*38	//Sold out Date for Product1
PA1*2*25*	
PA5*181201*1628*9	//Sold out Date for Product1
PA1*3*25*	
PA5*181120*1611*9	//Sold out Date for Product1
PA1*4*25*	
PA5*181120*1611*13	//Sold out Date for Product1
PA1*5*25*	
PA5*181201*1704*12	//Sold out Date for Product1
PA1*6*25*	
PA5*181201*1706*10	//Sold out Date for Product1
PA1*7*25*	
PA5*181119*0757*16	//Sold out Date for Product1
MA5*TUBE1**0*0*0*0	//Info about Coin tube

Inventory Status Message

- The sold out date for each product is compared with the Audit Read Date
- If they are the same, the product is considered sold out
- The cell in the code representing its status is set high

Inventory Status Message (Contd.)

- Machine ID is obtained from the field
- Compare the Audit Read Date and Sold out Date for each product
- If the two dates are the same, Product is sold out
- Check coin info (Not applicable for this machine)
- Sample Code generated using the DEX Info

Machine ID

6	1	5	0	2	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---

Code showing Inventory Status

0	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

Products(1-7)

Coin/Bills

Encryption Algorithm

VENDING MACHINE

InvCode

0	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

KEY1

1	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

EncCode

0	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

PromoCode

0	0	0	1	1	0	0	1
---	---	---	---	---	---	---	---

KEY2

1	0	1	0	1	0	1	0
---	---	---	---	---	---	---	---

InvCode

0	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

APPOLIS

EncCode

0	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

KEY1

1	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

InvCode

0	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

InvCode

0	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

KEY2

1	0	1	0	1	0	1	0
---	---	---	---	---	---	---	---

PromoCode

0	0	0	1	1	0	0	1
---	---	---	---	---	---	---	---



Decrypting the Message

MachineID

6	1	5	0	2	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---

InvCode

0	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

MachineID

0-9

Identify/locate the vending machine

InvCode

0-6

Indicates which products are running low

InvCode

7

Indicates coin/bill emergency

Hardware

- Development board (iPac-9302)
- Daughter board (LCD2S)
- Liquid Crystal Display (LCD)
- Keypad (4x3)
- Light Emitting Diode (LED)
- Enclosures

Keypad

3x4								
		Standard						
BUTTON LOCATION	1	●			●			
	2		●		●			
	3			●	●			
	4	●				●		
	5		●			●		
	6			●		●		
	7	●					●	
	8		●				●	
	9			●			●	
	10	●						●
	11		●					●
	12			●				●
		5	6	7	1	2	3	4
TERMINAL LOCATION								

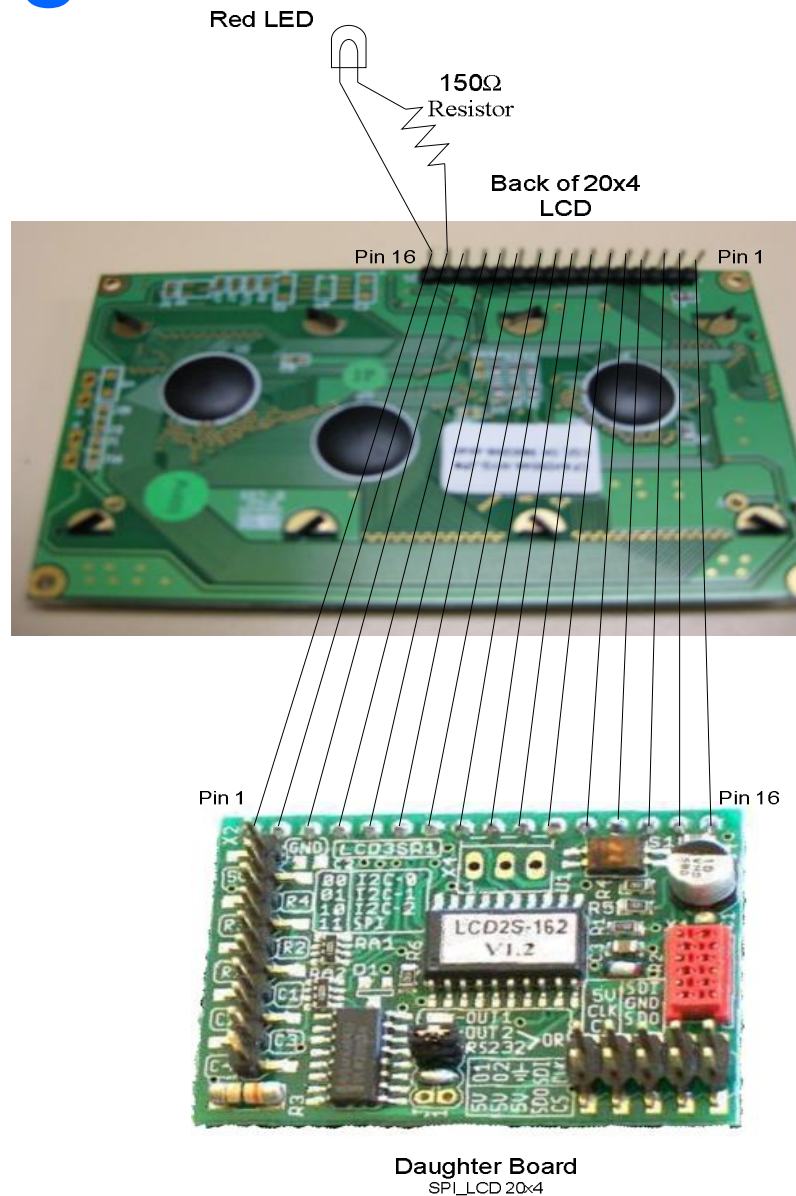
Pin 5 ↓	Pin 6 ↓	Pin 7 ↓	
1	2	3	← Pin 1
4	5	6	← Pin 2
7	8	9	← Pin 3
*	0	#	← Pin 4

- Picture at left courtesy of Grayhill, Inc.
Website:
<http://lgrws01.grayhill.com/web/images/ProductImages/Series%2096%20Standard%20Keypads.pdf>
- Picture above courtesy of Shannon Earley

Schematics

- Daughter Board, LCD, & LED
- Keypad, Daughter Board, & Development Board
- Power Connections

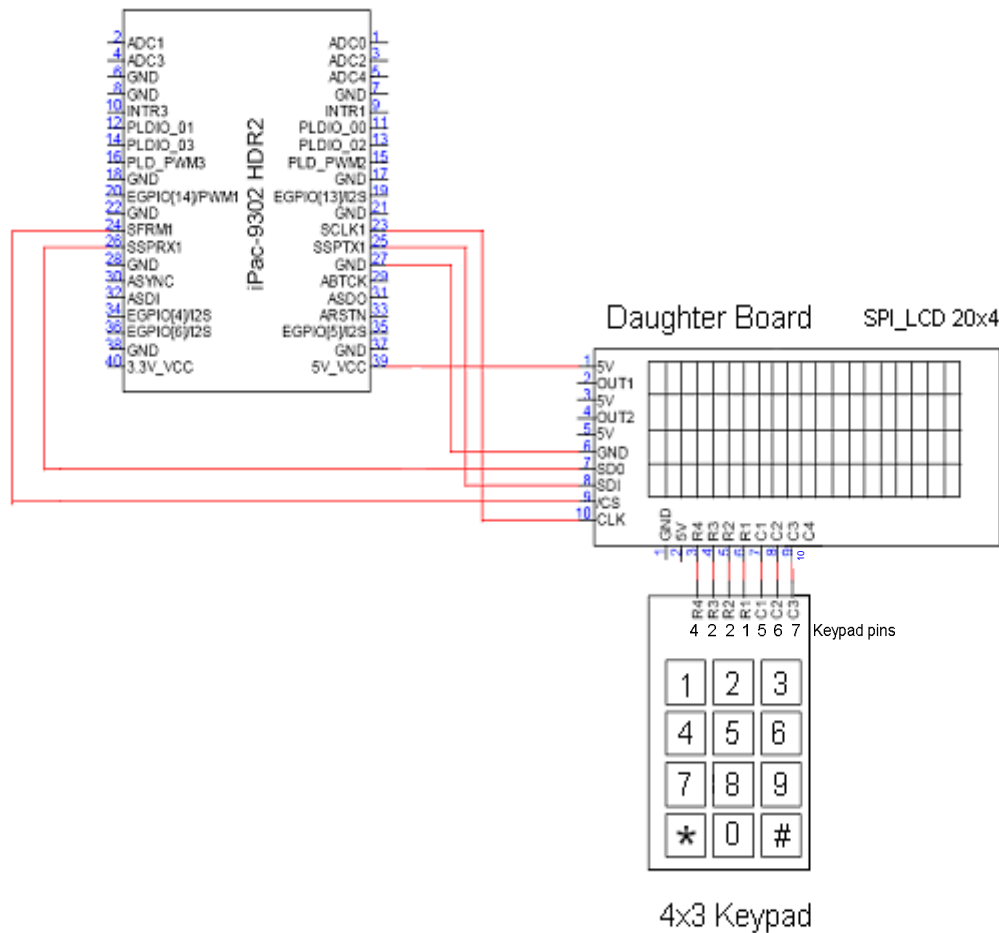
Daughter Board, LCD, & LED



- Pins align between daughter board and LCD
- Pins 15 and 16 on LCD intended for Backlight
- Resistor limits current drawn by LED

Keypad, Daughter Board, & Development board Schematic

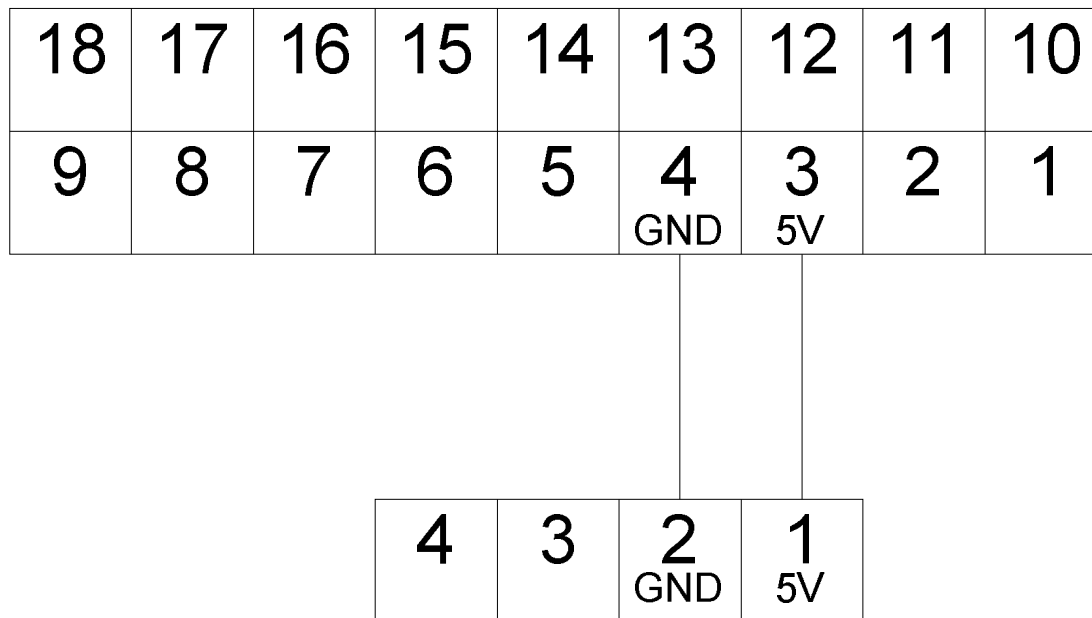
Header 2 on
development board iPac-9302



- Pins 1, 2, and 10 not used on daughter board header X2

Power Connections

Coin Changer Interface (P7)



Alternate Power
Connector HDR4 on
Development Board

Pictures

